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ABSTRACT

There are now many educational organizations and institutions that have decided to pursue flexible delivery and online learning as strategies. While many educators value online delivery of programs for the flexibility and opportunities offered, the environment offers far more than these outcomes alone. Online delivery supports and encourages very powerful learning environments and has the prospect to transform education if approached in the correct fashion. Across the world, conventional approaches to the design and development of online learning environments in higher education frequently result in many lost opportunities for both teachers and learners. These losses often arise as a consequence of a failure of many teachers to see the big picture when creating their own learning settings. This paper explores this big picture by examining the notion of reuse and recycling in online learning. It explores the concept of learning objects and how these can and should be considered in the design and development stages of online learning. The paper discusses outcomes and presents findings in the context of the Australian Flexible Learning Framework Online Product Development, Review and Evaluation project, a large project seeking to develop world-class online learning products. Characteristics supporting the design of reusable learning objects and challenges to developing learning designs with reusable learning objects are summarized. (Contains 23 references.) (Author/MES)

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LEARNING OBJECTS: SUPPORTING FLEXIBLE DELIVERY OF ONLINE LEARNING

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Abstract

There are now many educational organizations and institutions that have decided on flexible delivery and online learning as strategies that they are keen to pursue. While many educators value online delivery of programs for the flexibility and opportunities offered, the environment offers far more than these outcomes alone. Online delivery supports and encourages very powerful learning environments and has the prospect to transform education if approached in the correct fashion.

Across the world, conventional approaches to the design and development of online learning environments in higher education frequently result in many lost opportunities for both teachers and learners. These losses often arise as a consequence of a failure of many teachers to see the "big picture" when creating their own learning settings. This paper seeks to explore this big picture by examining the notion of reuse and recycling in online learning. It explores the concept of learning objects and how these can and should be considered in the design and development stages of online learning. The paper discusses outcomes and presents findings in the context of the Australian Flexible Learning Framework Online Product Development, Review and Evaluation project, a large Australian project seeking to develop world-class online learning products.

Keywords

World Wide Web, flexible delivery, instructional design, learning objects, online learning, reusable resources

Introduction

For many years, people have been critical of the development processes often used in building instructional and educational software systems (eg. Bates, 1999). In many instances, the development has resembled that used in cottage industries where a small number of people take responsibility for all aspects of the process and where the product is destined for small-scale use in limited settings (eg. Hanley, Schneebeck & Zweier, 1998). Bates (1999) uses the term *lone ranger* to describe much of the development occurring in educational institutions where many enthusiastic novices work independently on small scale projects to support their own teaching.

Many barriers exist to hinder the move to online learning. Among these the major impediments are recognised as stemming from the organisational factors associated with systemic change (eg. Anderson & Downes, 2000). With the increased uptake of online delivery within education, many writers are now questioning conventional development strategies and exploring more efficient and more productive ways to design and develop online learning materials. Strategies and activities that are currently being used in different settings to create more cost-effective solutions for online

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delivery of educational programs include:

- the development of national frameworks to support and develop online learning resources (eg. Anderson & Downes, 2000; ANTA, 2001; Education Network Australia, online);
- the development of libraries and databases of online learning resources for sharing and reuse, for example, Ariadne, MERLOT, LRX: and SoURCE, (all online);
- consortia among institutions to create larger markets, for example, Universitas 21 (online); and
- the development of specialist organisations that broker instructional materials, technical delivery support and learner support services for institutions (eg. Farrell, 2000).

Within and among all these various activities, there is a high degree of activity that extends across all phases, from design and development of online learning materials through to implementation and delivery strategies. It is within the context of design and development that this paper is set. There is growing recognition that the design and development strategies of online learning materials have to this point been very insular and localised and people are beginning to recognise the advantages of more open and outward looking approaches. In particular, the forms of design and development undertaken are starting to follow some fundamental patterns and processes that provide scope for reuse and recycling of the constituent elements. Critical to the success of many of these activities is the concept of learning objects.

Learning Objects

With the proliferation of online learning courses and materials, the Web is now replete with vast amounts of duplicated data and information. Early designers of Web-based materials focused heavily on developing online content and the majority of Web courses were based on delivery of these resources. Current design processes are now looking to maximise the reuse of learning materials and this has led to a number of reconsiderations in terms of the design and development of online learning settings.

Reusable learning objects are now being seen as the fundamental components and building blocks of online learning courses. A learning object is any entity, be it digital or non-digital that may be used for education and training (IEEE, 2001). In the context of online learning, these objects take such forms as Web pages, pdf documents, database applications, animations, Java applets, PowerPoint presentations and QuickTime movies. In the context of the Flexible Toolboxes, learning objects take a broader context and form and are defined more in terms of their educational properties, for example as learning elements, modules and assessment items.

The concept of online learning courses based around the use of reusable learning objects selected from large databases and repositories is not new. Even before the advent of the Web, such visionaries such as Ted Nelson (Nelson, 1965) and Roy Stringer (Stringer, 1992) were describing settings where information and course design was based on the use of resusable objects taken from interconnected digital libraries. The development of the Web has made possible such visions and much of the contemporary work in the field of online learning design and development is based, or influenced, in some way by the concept of such entities.

The entities needed to realise the visions of reusable digital objects are, in essence, digital forms of conventional libraries. Emerging storage and networking technologies have contributed significantly in recent years to the development of quite powerful functionalities for digital and multimedia libraries. The development of standards for the storage, cataloguing and classification of digital elements has significantly enhanced the discovery and delivery capabilities of the digital data within these networked systems.

Within educational contexts, the development of learning objects as an underpinning characteristic of the design of online learning environments involves two main considerations in the design process: the design of learning tasks and the selection of learning resources. While the concept of learning objects is relatively easily discussed and described in general terms, it becomes a little

more complex in the operationalisation stage. In this stage, it is essential to discover the precise forms that learning objects can take.

Contemporary Learning Designs in Higher Education

Contemporary online learning development in HE is moving away from the notion of learning settings being comprised of pages of electronic text, to more deliberately planned learning designs, learning tasks and processes structured in deliberate ways. In previous settings, instructional design had focused on developing pathways for learners through learning content, whereas in contemporary settings the designs are now focussing on providing learning activities that bring about planned learning outcomes.

In previous settings, learning content was chosen in the initial design process and the instructional design concerned itself with creating tasks and challenges that helped learners to understand the content being presented and to consolidate their knowledge acquisition. In online settings, these types of activities tended to represent situations where students learned from the information presented by, and through, the technology (eg. Dehoney & Reeves, 1999).

In contemporary settings, instructional design places far less emphasis on content and information as knowledge to be learned. It looks to the provision of learning designs that guide learners through roles and responsibilities that reflect real and relevant applications and contexts. A principal aim of the instructional design is to create student-centred settings that support students' development of self-learning, metacognition and collaboration with others. The content becomes a means to an end rather than an end in itself and learning is mediated by the technology applications (eg. Duschatel, 1997).

Contemporary forms of instructional design can be well supported by the concept of learning objects. The critical factor required for success is the separation of learning designs and learning resource (eg. Oliver, 2001). In conventional settings, learning objects have tended to contain a blend of information and instruction. Instructional designers have previously been inclined to create learning materials where the voice of the teacher was carried through the description of the content. While this created a perfect setting for an instructional text, it created very limited settings for learning and even more limited settings for reusability and reuse of the learning materials.

The learning environments that promote the objectives of contemporary teaching are well supported by online learning settings constructed with learning objects (eg. Downes, 2000). Some learning objects can be used as the framework for learning designs while others can be used as the resources to support learning.

Objects for Learning Design

There are a number of software tools available today that can be used to develop online learning environments based on particular learning designs. In this context, a learning design represents a deliberate set of learner activities and roles within a specific context whose completion is likely to bring about the development of particular forms of knowledge, skills and understanding. A role-playing activity is a good example of a learning design. It represents a planned and coordinated set of tasks within a setting, the process of which will cause conceptual change among the learners. The levels and forms of conceptual change will depend very much on the background of the learners, their roles and responsibilities within the activity and the forms of collaboration, articulation, reflection and self-regulation involved.

Learning designs can often be described in decontextualised fashions but are always applied in a specific context. It is possible, for example, to build a learning object to act as a framework for the role playing activity described above. The object might take the form of a Web-based database that a teacher could use to create a setting for a particular subject context. The information and content required to support the role playing learning activity could also be learning objects chosen from a

repository. The overall learning setting for the whole activity could be delivered to students through a standard courseware delivery system, such as WebCT or Blackboard. Such a system would also provide various forms of learner support such as discussion boards, noticeboards and chatrooms supporting the various forms of learner interaction.

The Australian Flexible Learning Framework Online Product Development, Review and Evaluation Project

There is currently a large amount of development activity surrounding Web-based materials that is looking to promote and encourage the notion of learning objects as the building blocks of online learning settings. A major project within Australia that is promoting these principles is the Australian Flexible Learning Framework Online Product Development, Review and Evaluation project funded through the Australian National Training Authority (ANTA) under the five-year strategy plan of the Australian Flexible Learning Framework (online).

The mission of ANTA is to ensure that the skills of the Australian labour force are sufficient to support internationally competitive commerce and industry and to provide individuals with opportunity to maximise their potential. ANTA's agenda has been to deliver training more responsively and efficiently and to a wider catchment area (ANTA, 1998). The Authority recognises that technological advances have been the catalyst for new forms of educational and training communication systems and that the demand for, and supply of vocational education and training is globalising. Consequently, it has enacted and sponsored strategies to encourage the vocational education and training providers to provide more flexible, technological-based, delivery for domestic and international markets. ANTA recognised that implications of technology advances and globalisation required new ways of creating and customising training material (Eccles, 1998). The Toolbox initiative was one of ANTA's strategies to encourage development and delivery of more flexible learning materials for the training market – particularly for online learning. Since 1998, ANTA and the Australian VET sector has invested over $20 million in "toolboxes" with the aim of producing a smorgasbord of multimedia resources from which providers can pick and choose in designing online training programs (Eccles, 1998).

The setting of a national framework with many discretionary elements provided a perfect opportunity for the Australian National Training Authority to explore the concept of online learning and in particular flexible forms of resource development and delivery to support learning. In the first instance, any products developed in this setting would have widespread application providing significant economies of scale. Secondly, the use of online technologies appeared to provide and promote the many forms of flexibility associated with the delivery of the Training Packages in the national setting.

The guidelines describing the Toolbox philosophy are aligned very much with those of the design and development of learning objects. Toolboxes are expected to allow for wide applicability across the target audience for whom they are intended. For this reason they are expected to be flexible, portable to a range of delivery platforms, and readily customised. They are designed to be:

- developed with readily available non-proprietary development software to facilitate customisation and reuse;
- developed with HTML code where customisation can be anticipated, with more sophisticated development software (eg. Flash) reserved for components that are unlikely to be changed;
- platform independent resources which allow for maximum portability to delivery platforms;
- devoid of rigid structuring devices locking the learner into particular learning pathways;
- developed using a file and directory structure that facilitates the location or selection of a particular learning object, as well as the use of the whole Toolbox;
- usable across a variety of platforms and browsers;
- consistent with the W3C content accessibility guidelines; and
- to embrace the EdNA metadata standard, a variation of IMS metadata standards used in the Australian educational setting.

The experience of the Australian Flexible Learning Framework Online Product Development, Review and Evaluation project to date has involved the development of online resources for over 25 Training Packages. This has been an enormous undertaking and represents the development of online resources for nearly 500 discrete units of study. The experience of the project has been to identify some critical factors associated with the design of flexible online learning resources which support customisation, and reuse, the principal characteristics of learning objects. These factors are summarised in Table 1.

Characteristic	Evidence in Design
Interoperability	Interoperability describes the capacity of items of software or hardware to work together. In the context of online learning, interoperability is usually associated with the design of Web-based resources that can operate across various forms of hardware platform, browser type and courseware delivery system. In the design and development of Web-based learning materials, interoperability can be considered at various levels. Some strategies supporting interoperability include: use of HTML standards; prescriptive use of Javascripts; use of plug-ins; use of standard screen sizes and colours; use of styles and style sheets; and standardised file organization and structure, file naming conventions and file sizes etc.
Organisation	Online learning environments are comprised of many individual elements. In order to be reusable, these elements need to be organised and classified in ways that encourage and facilitate discovery and relocation. A critical factor in designing learning settings that encourage this is the use of metadata standards. These standards need to be applied in consistent and reliable ways to ensure the integrity of the resources in instances where they are sought for reuse.
Scalable Use	Often when online resources are developed, they are designed with the immediate context in mind. Reusable objects need to be designed in ways that are flexible enough to cater for levels of use that may exceed (or fall within) the immediate setting. Scalable materials can be used with cohorts of 10, 100 or 1000. When scalability is not considered in the design phase, reusability can become quite limited.
Customisation	Reusable learning objects can serve many new purposes if there is some scope in their design for their use in alternative contexts to be considered. Customisation of learning objects can take many forms including teachers being able to choose between elements, making minor textual changes to elements, changing Web links etc. In instances where different forms of use for the objects may exist, customisation is enhanced by the provision of choices and options in the forms of application made.
Learning Designs	The design of learning objects where the instructional elements are separated from the resources and media elements provides many opportunities for reuse and resource sharing. The separation creates the possibility of customisation of both the learning activities and the supporting resources and high levels of flexibility in the choices made about each. The use of generic learning designs is an invaluable strategy supporting this characteristic.

Table 1: Characteristics supporting the design of reusable learning objects

The Challenges

As well as demonstrating the strategies and processes that can support the design of flexible learning settings based on reusable learning objects, the Australian Flexible Learning Framework Online Product Development, Review and Evaluation project has also served to provide evidence of challenges that act to constrain the achievement of the full potential of this design philosophy. Table 2 lists the challenges that have become evident through the progress of this project.

Challenge	Evidence and Implications
Granularity	The project has identified a number of difficulties and issues associated with the development of a functional definition for the concept of a learning object. The term means different things to different people and the lack of consistency in definition and description has proven to be limiting in terms of developing a common understanding and sense of application. In particular the notion of grain size and scope of learning objects is an area that requires immediate attention.
Learning Designs	The development of generic learning designs that support the use of learning objects has been both a support and a challenge for the project. It provides a challenge because it supports contemporary teaching approaches and encourages student-centred learning while teachers and students are predominantly proponents (and experts) in more conventional modes. The use of these design forms can act to discourage teachers whose preferred instructional formats are more in line with conventional than contemporary learning strategies.
Storage	The development of reusable learning objects is one phase in the project but developing a means to store the objects in repositories that can serve them represents perhaps a bigger challenge. Most institutions are comfortable with serving materials from local servers. They are perhaps less comfortable with serving the material of others or providing open access to other institutions to their own resources. Developing systems that encourage and support resource sharing is a challenge yet to be faced by most providers of online learning.
Discovery	The Web is a large place and the whole intention of reusable learning objects is to cut down on the duplication of objects. But providing sound and reliable ways for others to discover learning objects that are available for reuse is yet to be achieved. Within the Web, it is impossible often to distinguish between proprietary resources and those that can be freely used and amended. As learning designs become more and more based on the use of reusable objects, there will be a growing need for systems that market and discover the available resources and provide some sense of their value and quality.
Sharing	Coupled with the need for discovery is also the need for some systems to be generated that can manage the resource sharing activities. Some resources cannot be provided free of charge. The best resources will cost money to develop and developers will need to recoup costs if they are to continue their developments. Automated systems will need to be developed that can track resource sharing and provide some efficient means of calculating and determining costs and managing the payment of such.

Table 2: Challenges to developing learning designs with reusable learning objects

At this stage in the Australian Flexible Learning Framework Online Product Development, Review and Evaluation project, the Project Managers are now exploring strategies associated with the storage and dissemination of the learning resources. At the current time the processes are providing the means for use and reuse of learning objects within the various discrete projects to support flexible use and customisation. The next big challenge for the project and its national body is to consider ways and means for the vast arrays of resource elements, learning objects, to be stored and accessed in a fashion which would make them usable between and beyond the immediate projects for which they were created. This is clearly a challenge which when solved will provide guidelines for the large-scale dissemination of many other sources of other reusable learning elements currently in Australian education hyperspace.

Implications for Practice

Most of the activities associated with designing online learning environments based on the principles of reusable learning objects are being reported by the developers of large projects. Within most institutions, there is growing awareness of these approaches but until now, there has been relatively little activity undertaken to ensure or guarantee that online learning settings are being designed in ways that promote flexible use of the learning resources. This paper has discussed the basic principles behind the design processes and provided examples of projects in the local setting where such initiatives are being undertaken.

The use of learning objects as a component of the design and development process of online learning settings provides a number of advantages which value add to the process. In the first instance the fragmentation of the development into objects provides strong incentives and supports for contemporary instructional design that focuses on the provision of authentic contexts and settings for learning. In the second instance, the process recognises and supports the reuse of learning materials, and creates opportunities for large-scale savings in both development times and costs. It is highly likely that the principles described in this paper will soon become common elements of online learning design and development at all levels.

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